NATO Science for Peace and Security Series B: Physics and Biophysics 2009, pages 271-287

Contribution of copper Nqr spectroscopy to the geological studies of complex sulfides and oxides

Gainov R., Dooglav A., Mukhamedshin I., Evlampiev I., Orlova A., Pen'Kov I., Mozgova N.
Kazan Federal University, 420008, Kremlevskaya 18, Kazan, Russia

Abstract

Many energy-related areas such as nuclear waste isolation, continental drilling, fossil fuel recovery, and geothermal energy are directly associated with an in-depth understanding of the earth sciences. Of particular interest is the development of analytical techniques which can augment existing ones in developing a better understanding of mineralogy. Presently, available instrumental techniques for studying mineralogical problems such as x-ray, electron and neutron diffraction, nuclear gamma resonance (NGR or Mössbauer spectroscopy), electron microscopy and transmission electron microscopy have inherent limitations. These manifest themselves in being unable to characterize mineral samples fully, especially if they are polycrystalline. Nuclear Quadrupole Resonance (NQR) spectroscopy offers the potential for being able to obtain accurate high resolution spectra. These can then be interpreted to give structural information which can be related to local electronic structure, atomic arrangement, order/disorder phenomena, and crystal phase transformation. In addition, internal dynamics (ionic diffusion, metallic behavior, rotations, and so on) in the solid state can be studied. Furthermore, since NQR data are sensitive to changes in temperature and pressure, there is the possibility of obtaining stress/strain information. As applied to mineralogical and geological problems, NQR can also provide additional information, for example: chemical activity of minerals (genetic and technological aspects) at different hydrothermal conditions, the studies of impurity configurations in ore minerals and their distribution in crystal lattice, and other. This chapter highlights some NQR studies in copper sulfides, which demonstrate how NQR method can contribute to our understanding of geological problems. Examples are taken primarily from author's investigate groups. © 2009 Springer Science+Business Media B.V.

http://dx.doi.org/10.1007/978-90-481-3062-7-17

Keywords

63, 65Cu NQR, Copper sulfides, Oxides